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Chemistry Assignment

1. Give the IUPAC names of the following compounds

- i. HCOOH
- ii. HOOCCH₂CH₂CH₂COOH
- iii. HO₂C-CO₂H
- iv. CH₃CH₂CH₂COOH
- v. CH₃(CH₂)₄COOH
- vi. CH₃CH=CHCH₂CH₂COOH

Answers

COMPUNDS	IUPAC NAMES
HCOOH	Methanoic acid
HOOCCH ₂ CH ₂ CH ₂ COOH	Butanedioic acid
HO ₂ C-CO ₂ H	Oxalic acids
CH ₃ CH ₂ CH ₂ COOH	Butanoic acid
CH ₃ (CH ₂) ₄ COOH	Hexanoic acid
CH ₃ CH=CHCH ₂ CH ₂ COOH	propan-2-ol

2. Discuss briefly the physical properties of carboxylic acids under the following headings

- i. Physical appearance :::::
- ii. Boiling point
- iii. Solubility

Answers

- i. Physical appearance: Carboxylic acids have high boiling points compared to other substances of comparable molar mass. Boiling points increase with molar mass. Carboxylic acids having one to four carbon atoms are completely miscible with water. Solubility decreases with molar mass.
- ii. Boiling point: Carboxylic acids tend to have higher boiling points than water, because of their greater surface areas and their tendency to form stabilised dimers through hydrogen bonds. For boiling to occur, either the dimer bonds must be broken or the entire dimer arrangement must be vaporised, increasing the enthalpy of vaporization requirements significantly.
- iii. Solubility: Carboxylic acids are polar. Because they are both hydrogen-bond acceptors (the carbonyl -C=O) and hydrogen-bond donors (the hydroxyl -OH), they also participate in hydrogen bonding. Together, the hydroxyl and carbonyl group form the functional group carboxyl. Carboxylic acids usually exist as dimers in nonpolar media due to their tendency to "self-associate". Smaller carboxylic acids (1 to 5 carbons) are soluble in water, whereas higher

carboxylic acids have limited solubility due to the increasing hydrophobic nature of the alkyl chain. These longer chain acids tend to be soluble in less-polar solvents such as ethers and alcohols. Aqueous sodium hydroxide and carboxylic acids, even hydrophobic ones, react to yield water-soluble sodium salts. For example, enanthic acid has a low solubility in water (0.2 g/L), but its sodium salt is very soluble in water.

3. Write two industrial preparations of carboxylic acids

Answers

- I. Oxidation of hydrocarbons using air: For simple alkanes, this method is inexpensive but not selective enough to be useful. Allylic and benzylic compounds undergo more selective oxidations. Alkyl groups on a benzene ring are oxidized to the carboxylic acid, regardless of its chain length. Benzoic acid from toluene, terephthalic acid from para-xylene, and phthalic acid from ortho-xylene are illustrative large-scale conversions. Acrylic acid is generated from propene
- II. Carbonylation of alcohols as illustrated by the Cativa process for the production of acetic acid. Formic acid is prepared by a different carbonylation pathway, also starting from methanol.

4. With equations and brief explanation discuss the synthetic preparation of carboxylic acid

Answers

- i. Carbonation of a Grignard reagent and organolithium reagents:
$$\text{RLi} + \text{CO}_2 \rightarrow \text{RCO}_2\text{Li}$$
$$\text{RCO}_2\text{Li} + \text{HCl} \rightarrow \text{RCO}_2\text{H} + \text{LiCl}$$
- ii. Base-catalyzed cleavage of non-enolizable ketones, especially aryl ketones: $\text{RC(O)Ar} + \text{H}_2\text{O} \rightarrow \text{RCO}_2\text{H} + \text{ArH}$